September 21, 2001

Magalie R. Salas, Esq.
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Re: CC Docket No. 00-218
In the Matter of Petition of WorldCom, Inc. Pursuant to Section 252(e)(5) of the Telecommunications Act of 1996 for Expedited Preemption of the Jurisdiction of the Virginia State Corporation Commission Regarding Interconnection Disputes with Verizon Virginia, Inc., and for Expedited Arbitration

Re: CC Docket No. 00-251
In the Matter of Petition of AT&T Communications of Virginia, Inc., TCG Virginia, Inc., ACC National Telecom Corp., MediaOne of Virginia and MediaOne Telecommunications of Virginia, Inc. for Arbitration of an Interconnection Agreement With Verizon Virginia, Inc. Pursuant to Section 252(e)(5) of the Telecommunications Act of 1996

Dear Ms. Salas:

On behalf of WorldCom, Inc. and AT&T Communications of Virginia, Inc. and its affiliates listed above, enclosed please find an original and three (3) copies of the surrebuttal testimony and exhibits of Brian F. Pitkin, Richard B. Lee, Michael R. Baranowski, Catherine E. Pitts, John I. Hirshleifer, Joseph P. Riolo, Steven E. Turner, Terry L. Murray and the Panel Surrebuttal Testimony on Non-Recurring Costs and Advanced Data Services. Proprietary copies of the testimony of Michael R. Baranowski, Steven E. Turner, Brian F. Pitkin, Joseph P. Riolo and the Panel Surrebuttal Testimony on Non-Recurring Costs and Advanced Data Services will be filed under separate cover.

Sincerely yours,

Allen M. Freifeld
WorldCom, Inc.
1133 19th Street, NW
Washington, DC 20036
202 736-6104

Mark A. Keffer
AT&T
3033 Chain Bridge Road
Oakton, VA 22185
703 691-6046

cc: Service List
Enclosures

Before the
Federal Communications Commission
Washington, D.C. 20554

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CERTIFICATE OF SERVICE

I hereby certify that on this 21st day of September, 2001, a copy of the surrebuttal testimony of Brian F. Pitkin, Richard B. Lee, Michael R. Baranowski, Catherine E. Pitts, John I. Hirshleifer, Joseph P. Riolo, Steven E. Turner, Terry L. Murray and Panel Surrebuttal Testimony on Non-Recurring Costs and Advanced Data Services filed on behalf of AT&T and WorldCom was sent via email and, on the 24th day of September, 2001, a paper copy will be sent via hand delivery and/or Federal Express to:

Dorothy Attwood, Chief
Common Carrier Bureau
Federal Communications Commission
Room 5-C450
445 12th Street, S.W.
Washington, D.C. 20544

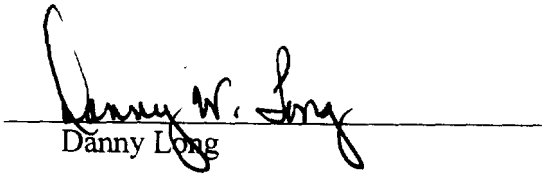
Jeffrey Dygert
Assistant Bureau Chief
Common Carrier Bureau
Federal Communications Commission
Room 5-C317
445 12th Street, S.W.
Washington, D.C. 20544

Katherine Farroba, Deputy Chief
Policy and Program Planning Division
Common Carrier Bureau
Federal Communications Commission
Room 5-B125
445 12th Street, S.W.
Washington, D.C. 20544

Jodie L. Kelley, Esq.
Jenner and Block
601 13th Street, NW
Sute 1200
Washington, DC 20005
(for WorldCom)

Jill Butler
Vice President of Regulatory Affairs
Cox Communications, Inc.
4585 Village Avenue
Norfolk, Virginia 23502

Karen Zacharia, Esq.
Verizon, Inc.
1320 North Court House Road
Eighth Floor
Arlington, Virginia 22201



Danny Long

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of Petition of AT&T Communications of Virginia, Inc., Pursuant to Section 252(e)(5) of the Communications Act, for Preemption of the Jurisdiction of the Virginia State Cooperation Commission Regarding Interconnection Disputes with Verizon-Virginia, Inc.	CC Docket No. 00-251
In the Matter of Petition of WorldCom, Inc. Pursuant to Section 252(e)(5) of the Communications Act for Expedited Preemption of the Jurisdiction of the Virginia State Corporation Commission Regarding Interconnection Disputes with Verizon-Virginia, Inc., and for Expedited Arbitration	CC Docket No. 00-218

SURREBUTTAL TESTIMONY OF

BRIAN F. PITKIN

ON BEHALF OF

AT&T COMMUNICATIONS OF VIRGINIA, INC.

and

WORLDCOM, INC.

PUBLIC VERSION

September 21, 2001

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Brian F. Pitkin. I am a Director in the Financial Consulting Division of FTI Consulting, Inc., with offices located at 66 Canal Center Plaza, Suite 670, Alexandria, Virginia 22314.

Q. ARE YOU THE SAME BRIAN F. PITKIN WHO FILED DIRECT TESTIMONY IN THIS PROCEEDING?

A. Yes, I am.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my surrebuttal testimony is to respond to certain aspects of the Rebuttal Testimony filed on August 27, 2001, on behalf of Verizon Virginia, Inc. ("Verizon - VA") by Francis J. Murphy and Timothy J. Tardiff.

Q. ARE THERE ANY EXHIBITS TO YOUR SURREBUTTAL TESTIMONY?

A. Yes, I am attaching one exhibit.

Q. HOW IS YOUR TESTIMONY ORGANIZED?

A. In this section, I provide an overview of the remainder of my testimony. In Section II, I deal with certain economic/modeling issues raised in Messrs. Tardiff's and Murphy's rebuttal testimonies that relate to the capabilities of the FCC's Synthesis Model, as it was filed in the *AT&T/WorldCom Initial Filing* ("Synthesis Model"),[1] to develop TELRIC-compliant costs for UNEs in Virginia. In Section III, I address the unsupported and erroneous criticisms made by Messrs. Tardiff and Murphy of the Synthesis Model platform. In Section IV, I address the few criticisms made by Messrs. Tardiff and Murphy that have merit and discuss my responses to those points. Finally, in Section V, I summarize my testimony and present the restated Synthesis Model results after incorporating all appropriate changes and addressing the few valid points raised by Messrs. Tardiff and Murphy.

Q. CAN YOU PLEASE SUMMARIZE YOUR TESTIMONY?

A. In their rebuttal testimony, Verizon witnesses Tardiff and Murphy present a dizzying array of criticisms of the Synthesis Model and the specific inputs and model adjustments sponsored by AT&T and WCOM in this proceeding. As explained below, virtually none of these criticisms have merit. None undercuts the bedrock point that the Synthesis Model is the best tool for estimating the TELRIC of providing unbundled network elements in Virginia.

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[1] Cost Studies and Supporting Documentation Setting Forth Cost Model Outputs for Unbundled Network Elements and Associated Non-Recurring Charges Submitted by AT&T Communications of Virginia, Inc. and WorldCom, Inc., July 2, 2001, ("*AT&T/WorldCom Initial Filing*").

Many of the criticisms merely rehash arguments that were raised by ILECs and rejected by the Commission during its review and development of the Synthesis Model. Nearly all of the criticisms, whether new or recycled, rely on analyses or assumptions that are unsupported or plainly incorrect. Many the criticisms are also inconsistent with the positions or approaches Verizon has taken in its own cost studies. Other criticisms are essentially back-door attacks on the TELRIC standard itself.

The Synthesis Model represents the effort by this Commission to take the best aspects of the three state-of-art cost models and develop a mechanism for estimating forward looking economic costs. With minor modifications to the Synthesis Model as developed by this Commission, the model as submitted by AT&T and WorldCom (or "UNE-Compliant Synthesis Model") in this proceeding provides the best estimates of TELRIC in this record. Adopting these estimates in setting Verizon's UNE prices in Virginia will greatly advance the development of local exchange competition in Virginia.

Moreover, many criticisms raised by Messrs. Tardiff and Murphy are merely unsupported assertions. Verizon has chosen to put forth testimony in this proceeding about what the FCC intended the Synthesis Model to do. The FCC and the FCC Staff are clearly in the best position to know how the Synthesis Model was designed, what the model can do, how the model can be used, and what modifications to the Synthesis model are necessary to produce forward-looking UNE costs.

II. ECONOMIC/MODELING ISSUES

Q. ARE YOU THE ONLY AT&T WITNESS ADDRESSING ECONOMIC ISSUES IN THIS SURREBUTTAL FILING?

A. No. Ms. Terry Murray is the primary AT&T witness on economic matters. I am addressing certain issues that relate to the implementation of the economic principles Ms. Murray discusses.

A. The Synthesis Model is the Best Tool Available for Estimating the TELRIC of Providing UNEs for Verizon-VA

Q. IS THE SYNTHESIS MODEL THE BEST AVAILABLE TOOL FOR ESTIMATING THE TELRIC OF PROVIDING UNES FOR VERIZON-VA?

A. Yes. Despite the testimony of Messrs. Tardiff and Murphy to the contrary, and as discussed more fully in my direct testimony and in the testimony of Ms. Murray, the Synthesis Model is the best tool for estimating the TELRIC of providing unbundled network elements in Virginia.

- The Synthesis Model uses forward looking economic cost principles to calculate the economic costs that an efficient company would incur to provide basic telephone exchange service;
- The Synthesis Model represents the efforts by the FCC, an objective third party, to take the best aspects of various existing cost methodologies in developing a model for deriving costs for universal support;

- The Synthesis Model incorporates consistent long run incremental cost principles that apply both to the development of universal service and the determination of costs for unbundled network elements;

- The Synthesis Model does not reward incumbent carriers for existing inefficiencies, but rather sends the correct economic signals for entry and investment;

- The Synthesis Model is flexible and allows the use of state-specific inputs; and

- The Synthesis Model allows the development of costs for individual unbundled network elements with only minor changes that can be reviewed and tested using the Model's adjustable algorithms and inputs; and

- The Synthesis Model has been subjected to rigorous review, spanning several years, from a wide variety of industry participants.

The bulk of the *Platform Order*[2] describes the model platform choices made by the Commission and explains why the model is superior at estimating the forward-looking economic costs of providing local telephone service using a network architecture that does not impede the ability to use the Internet and other advanced telecommunications and information services. The FCC does not identify *a single* component or assumption of the platform as inappropriate for use in developing forward-looking economic costs for UNEs or biased in cost. As the FCC observed:

> The model platform we adopt today combines the best elements from each of the three models currently in the record. The model platform we adopt today will allow the Commission to estimate the cost of building a telephone network to serve subscribers in their actual geographic locations, to the extent known. To the extent that telephone companies cannot supply the actual geographic location of the customer, the model platform assumes that those customers are located near roads. The model also allows the Commission to adjust engineering assumptions to reflect any evolution in the definition

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[2] *Federal-State Joint Board on Universal Service*, Fifth Report and Order, 13 FCC Rcd 21323, October 28, 1998 ("*Platform Order*").

> of supported services, and to assure that the model assumes a network architecture that will not impede rural Americans' ability to use the internet and other advanced telecommunications and information services. As such, we believe the federal model platform we adopt today will serve as a solid foundation for further decisions that will determine the amount of universal service support to be provided to non-rural eligible telecommunications carriers.
>
> *Platform Order* at 4.

Q. WHAT IS YOUR REACTION TO THE CLAIMS BY MESSRS. MURPHY AND TARDIFF THAT THE COMMISSION CANNOT USE THE SYNTHESIS MODEL TO DETERMINE THE COST OF UNBUNDLED NETWORK ELEMENTS?

A. Mr. Murphy has been a consistent critic of the Synthesis Model, claiming it was "cobbled together over many months"[3] and arguing that it was designed solely to allocate costs among states in USF proceedings. These criticisms ignore the extensive Commission deliberations that led to the development of the Synthesis Model through more than a dozen orders over the course of three years of proceedings. The chronology of Commission actions totally undercuts Mr. Murphy's claim that the Commission "cobbled together" or acted in an "expedient" manner in developing the Synthesis Model:

- The FCC determined that Universal Support would be based on the amount by which forward looking costs exceeded a revenue benchmark, and decided to develop its own cost model in the *First Report and Order*, released on May 8, 1997;[4]

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[3] Rebuttal Testimony of Francis J. Murphy, Case No. 8745, In the Matter of Provision of Universal Service to Telecommunications Consumers (Md. Pub. Ser. Commn.) (May 21, 2001), at 19. ("Murphy Maryland USF Rebuttal").

[4] *Federal-State Joint Board on Universal Service*, Report and Order, 12 FCC Rcd 8776, 8801, October 28, 1998 ("*First Report and Order*").

- The Synthesis Model platform was adopted in the *Platform Order*, released on October 28, 1998;[5]

- The first notion that support would be based on relative costs arose out of the *Second Recommended Decision*, released on November 25, 1998;[6]

- The FCC adopted the use of relative costs in the *Seventh Report and Order*, released on May 28, 1999;[7]

- The FCC determined that the costs used as the basis for the national benchmark would be based on the Synthesis Model in *Ninth Report and Order*, released on November 2, 1999;[8]

- The FCC adopted inputs for the Synthesis Model in the *Inputs Order*, released on November 2, 1999;[9]

- The FCC established a methodology for phasing out the "hold-harmless" provision for Universal Service in the *Thirteenth Report and Order*, released on December 8, 2000;[10]

In reaching its result, the Commission considered a wide range of viewpoints from all segments of the telecommunications industry, including the views of Verizon and its predecessor entities Bell Atlantic and GTE Corporation.[11] Indeed, a number of the arguments presented by Messrs. Murphy and Tardiff in their rebuttal testimony are

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[5] *Federal-State Joint Board on Universal Service*, Fifth Report and Order, 13 FCC Rcd 21323, October 28, 1998 ("*Platform Order*").
[6] *Federal-State Joint Board on Universal Service*, Second Recommended Decision, 13 FCC Rcd 24744, November 25, 1998 ("*Second Recommended Decision*").
[7] *Federal-State Joint Board on Universal Service*, Seventh Report and Order, 14 FCC Rcd 8094, May 28, 1999 ("*Seventh Report and Order*").
[8] *Federal-State Joint Board on Universal Service*, Ninth Report and Order, 14 FCC Rcd 20432, 20474, November 2, 1999 ("*Ninth Report and Order*").
[9] *Federal-State Joint Board on Universal Service*, Tenth Report and Order, 14 FCC Rcd 20156, November 2, 1999 ("*Inputs Order*").
[10] *Federal-State Joint Board on Universal Service*, Thirteenth Report and Order, December 8, 2000.
[11] In fact, no other cost model has undergone such an extensive review by as many participants from all industry segments than the FCC's Synthesis Model. By comparison, Verizon's model has received much less attention and review.

simply recycled arguments previously presented to – and rejected by – this Commission during its consideration of the Synthesis Model. These arguments are no more persuasive today than they were when the Commission originally rejected them.

Q. HOW LONG AGO DID THE FCC DECIDE TO USE FORWARD-LOOKING COST?

A. More than four years ago in the *First Report and Order*, the FCC affirmed the Joint Board's recommendation adhering to the economic principle of forward-looking costs. The FCC's criteria for forward-looking economic cost determinations included:

> The technology assumed in the cost study or model must be the least-cost, most-efficient, and reasonable technology for providing the supported services that is currently being deployed. Only long-run forward-looking economic cost may be included. The long-run period used must be a period long enough that all costs may be treated as variable functions, or elements.
>
> *First Report and Order* at 251

> We concur with the Joint Board's finding that the use of forward-looking economic costs as the basis for determining support will send the correct signals for entry, investment, and innovation.
>
> *First Report and Order* at 224

The FCC then developed the model platform on the basis of forward-looking costs.

> As the Joint Board recognized, providing support based on embedded cost provides the wrong signals to potential market entrants. If embedded costs exceed forward- looking costs, such support would encourage inefficient entry. In contrast, providing support based on embedded costs that are below forward-looking economic costs would dissuade market entry even where such competition would be economically efficient. The Commission concurred with the Joint Board's finding that the use of forward-looking economic costs as the basis for determining support will send the correct signals for entry, investment, and innovation. The Commission found that a forward-looking economic cost methodology creates the incentive for carriers to operate efficiently and tends not to give carriers an incentive to inflate their costs or to refrain from efficient cost-cutting.

Platform Order at 10.

Subsequently, in the *Seventh Report and Order*, the FCC established and sought comment on a methodology for determining non-rural carriers' support amounts, based on the forward-looking costs estimated using a national cost model, and a national cost benchmark. [12]

Finally, in the Tenth Report and Order the Commission reaffirmed its decision to base support calculations on forward-looking costs by the following statement:

> We have repeatedly articulated our reason for believing that forward-looking costs represent a superior method for determining support amounts. The most significant of these is that forward-looking costs are the basis of economic decision in a competitive market, and therefore send the correct signals for entry and investment.
>
> *Inputs Order* at 22.

Q. WHY IS THIS REAFFIRMATION IMPORTANT?

A. It is important that the FCC reaffirmed the use of appropriate forward-looking costs at each stage of development. In other words, this theoretical construct was created by design and adhered to throughout the development process, including the model platform and input selection. The reliance on this economic principle is a principle reason that a model developed for USF, based on appropriate forward-looking costs, can be used to develop appropriate forward-looking costs of UNEs.

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[12] *Seventh Report and Order* at 3.

Q. IS THE SYNTHESIS MODEL, AS MR. MURPHY CLAIMS, MERELY AN "EXPEDIENT APPROACH TO IDENTIFYING THE RELATIVE DIFFERENCES AMONG STATES REGARDING THE COSTS OF PROVIDING CERTAIN NARROWLY-DEFINED SERVICES SUPPORTED BY THE FEDERAL USF MECHANISM"?

[Tardiff @ 7-12, Murphy @ 10-14]

A. No. This criticism by Messrs. Murphy and Tardiff confuses the FCC's particular *application* of the Synthesis Model in the federal USF program with the *capabilities* inherent in the Synthesis Model Platform.

With respect to the capabilities of the Synthesis Model, the FCC's *Platform Order* states:

> Consistent with the Joint Board's recommendation, the Commission concluded in the *Universal Service Order* that it would need to estimate costs based on a careful analysis of efficient network design, engineering practices, available technologies, and current technology costs. That is, to estimate forward-looking costs accurately, the Commission decided to look at all of the costs and cost-causative factors that go into building a network. The Commission decided to do this in two stages: first, it would look at the network design, engineering, and technology issues relevant to constructing a network to provide the supported services. Second, the Commission said that it would look at the costs of the components of the network, such as cabling and switch costs, and various capital cost parameters, such as debt-equity ratios and depreciation rates ("input values"). Platform Order @ 11-12, (footnotes deleted).

> This Order includes our conclusions as to the platform selection, the first of the two stages. Below we adopt a synthesis of the best aspects of each of the three models before us in this proceeding. We recognize that, of necessity, models estimate the forward-looking cost of providing the supported services. Such analysis is, however, the only practicable method that presently exists for determining forward-looking costs on a widescale basis, and we expect that the synthesis model will generate accurate estimates of the forward-looking of providing the supported services.

Platform Order, footnotes deleted.

The FCC recognized two facts in deciding how to *apply* the Model in connection with the federal USF program. First, the size of the federal USF fund was initially more likely to be a top-down number that had to be allocated to the various states (and Puerto Rico and the District of Columbia) than a bottom-up calculation of the federal portion of USF on a state-by-state basis. Second, evaluating and approving state-specific (and, perhaps, company-specific) inputs for each state to determine the federal portion of USF in each state would place an enormous burden on FCC staff. For these reasons, the FCC decided to use the Model, with national inputs that are uniform for all states.[13]

As the *Platform Order* makes clear, however, the Synthesis Model platform is designed to do much more. The underlying Model algorithms employ state-specific customer demand, customer location and geological data to efficiently design plant and facilities on a geographically discrete basis. Furthermore, hundreds of inputs in the Synthesis Model can be modified, if necessary and appropriate, to reflect state-specific or company-specific characteristics. In short, there is nothing to prevent -- and much to recommend -- the use of the Synthesis Model in this proceeding.

Furthermore, the notion that a USF model cannot be used to develop UNE costs is baseless. The underlying elements necessary to provide basic local service are the very

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[13] Messrs. Tardiff and Murphy appear to suggest that the Synthesis Model as designed by the FCC systematically understates costs but that the FCC accepted this flaw because the Model was to be used only in connection with the determination of relative costs. (Tardiff at 25-26; Murphy at 5). This argument is demonstrably wrong, as the decision to rely on relative costs occurred after the adoption of the *Platform Order* which determined the methodology for calculating the investments and costs in the Synthesis Model. The FCC stated in the *Platform Order* that the Synthesis Model provided a reasonable estimate of forward-looking costs, and the Commission has never stated in any order that the Synthesis Model systematically understates costs, as Messrs. Tardiff and Murphy claim.

same elements at issue in both universal service and unbundled network element proceedings. The FCC itself has recognized the connection between the two processes:

> We also encourage a state, to the extent possible and consistent with the above criteria, to use its ongoing proceedings to develop permanent unbundled network element prices as a basis for its universal service cost study. This would reduce duplication and diminish arbitrage opportunities that might arise from inconsistencies between the methodologies for setting unbundled network element prices and for determining universal service support levels. In particular, we wish to avoid situations in which, because of different methodologies used for pricing unbundled network elements and determining universal service support, a carrier could receive support for the provision of universal service that differs from the rate it pays to acquire access to the unbundled network elements needed to provide universal service. Consequently, to prevent differences between the pricing of unbundled network elements and the determination of universal service support, we urge states to coordinate the development of cost studies for the pricing of unbundled network elements and the determination of universal service support.
>
> *First Report & Order* at 251.

The FCC and FCC Staff, as the developers of the Synthesis Model, recognize its capabilities. Thus, the Commission can appropriately determine the geographically-deaveraged costs with only minor modifications to the results presented in my Direct Testimony. Indeed, despite the repeated claims of Verizon witnesses that the Synthesis Model cannot be used as a basis for UNE costs, they provide almost no explanation of why they believe this is so. In fact, almost all of their criticisms of the Synthesis Model would apply equally to its use in determining universal service support criticisms that the Commission has appropriately rejected those criticisms during the development of the model.

B. The Synthesis Model Provides Sufficient Spare for Churn, Demand Fluctuations and Growth

Q. VERIZON ARGUES THAT THE SYNTHESIS MODEL REFLECTS "STATIC" NETWORKS THAT FAIL TO ACCOUNT FOR CHURN, DEMAND FLUCTUATIONS, AND DEMAND GROWTH. IS THIS ACCURATE?

[Tardiff @ 11-12, Murphy @ 21-22]

A. No. The Synthesis Model includes fill inputs that build substantial spare capacity into the network to handle churn, demand fluctuations, and demand growth. Significantly, these "target" fill factors actually provide spare utilization of the network at inception, because many assets -- particularly copper and fiber cable -- come only in discrete sizes. As a result, the model "rounds up" the facilities to the next highest capacity to provide sufficient capacity to meet the target fill criteria. For example, if a particular distribution area serves 55 working lines, and the model employs a 50% fill factor, this distribution area would need 110-pair cable. However, if cable comes in only 100-pair and 200-pair cable units, then the model installs a 200-pair cable, creating an effective fill of 27.5 percent (55 working pairs/200 available pairs). In short, the Synthesis Model has more than enough "play in the joints" to allow for "churn, irregularly distributed demand, fluctuations in demand and overall growth in demand" without "having to augment or replace facilities constantly."

In making their criticism, Messrs. Tardiff and Murphy simply disregard the fact that the Synthesis Model uses target fill factors.[14] In addition, they have provided no evidence

[14] In making his criticism, Dr. Tardiff has not developed effective fill factors to compare to the Synthesis Model's target fill factor. When Dr. Tardiff was asked in discovery to provide the effective fill factors supporting his

that the Synthesis Model fails to provide the necessary spare capacity and have provided no analysis to support this assertion. The Synthesis Model estimates the amount of plant required for current demand (*i.e.*, mid-year 2001).[15] For this period, the Synthesis Model results in an effective fill factor of 52.5% for distribution plant[16] -- precisely the amount that Messrs. Tardiff and Murphy assert is appropriate.

Q. HAS THE COMMISSION PREVIOUSLY CONSIDERED VERIZON'S ARGUMENTS REGARDING FILL FACTORS?

A. Yes. Messrs. Tardiff and Murphy are raising the same claims made during the inputs phase of the Synthesis Model development. Specifically, the FCC's *Inputs Order* at paragraphs 196-198 dismisses a number of GTE claims regarding fill factors, including the need to use a fixed number of lines per household rather than a utilization factor.

Q. VERIZON ARGUES THAT IT IS APPROPRIATE TO CHARGE TODAY'S CUSTOMERS FOR SPARE CAPACITY THAT IS REQUIRED TO SERVE FUTURE CUSTOMERS BECAUSE IT IS MORE EFFICIENT TO INSTALL CAPACITY ONCE RATHER THAN ADDING CAPACITY AS DEMAND GROWS. IS THIS CORRECT?

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criticisms, Verizon responded: "Verizon VA objects to this request on the ground that it is vague and ambiguous, and that Dr. Tardiff does not understand what is being requested." Response to AT&T/WorldCom 10-162.

[15] As I stated in my Direct Testimony, the rates established in this proceeding are likely to be in effect for several years. While I incorporated year-end 2002 line counts into the model platform, this is a computational convenience to reflect the mid-point over which rates are likely to be in effect (*i.e.*, half way between mid-2001 and mid-2004). Another way to have approached this issue would have been to use mid-year 2001 data in the model and then adjust the line counts used to estimate the average demand over the period the rates will be in effect.

[16] The mid-year 2001 total number of working lines assumed in my application of the Synthesis Model is 5,446,900. The Synthesis Model (as filed in the AT&T/WorldCom Initial Filing) constructs 10,374,272 available cable pairs at the SAI/FDI. Dividing the working lines by the available pairs equates to a 52.5% distribution fill factor.

[Tardiff @ 19-20]

A. This argument is unsound in several respects. First, it misses the point: once again, Verizon confuses the issue of how much spare capacity should be stockpiled in anticipation of future growth in demand with the separate issue who should pay for the cost of carrying that capacity until it is used to generate revenue. As Ms. Murray has previously explained, an effectively competitive market does not allow a firm to recover from current customers the costs of unused capacity installed in anticipation of serving future customers. Today's customers should not bear the full carrying costs of that spare capacity until tomorrow's customers materialize -- this is a cost that should be fully borne by tomorrow's customers, which is precisely what we observe in competitive markets.

Second, and in any event, the Synthesis Model provides sufficient capacity for churn and future demand. Input fill factors in the Synthesis Model are well below 1.0, which results in even lower *effective* fill factors (as discussed above). And as a result, the Synthesis Model provides a network capable of handling substantial growth in demand without having to "dig up the street twice."

As Mr. Riolo testifies, the fill factors employed in the Synthesis Model are sufficient to provide *both* forms of demand growth. As such, they overstate the TELRIC of serving today's demand. Contrary to Dr. Tardiff's claim, there is therefore *more* than enough spare capacity incorporated into the Synthesis Model run for Verizon-VA.

Q. HAS THE FCC RECOGNIZED THE NEED TO REFLECT GROWING DEMAND IN ESTIMATING FORWARD-LOOKING COSTS?

A. The FCC has clearly recognized the need to capture the lower costs associated with greater demand, which results in greater economies of scale and scope in telecommunications plant. This is quite obvious from the fact that the FCC re-runs the Synthesis Model each year for Federal USF purposes. If costs were not changing, there would be no reason to go through this exercise. Thus, the FCC, for Federal purposes, has chosen to re-run the Synthesis Model each year to reflect this growth. The Commission could choose to perform the same exercise here if it chooses to arbitrate UNE proceedings on a yearly basis.

Q. DOES INCLUDING SPARE CAPACITY FOR GROWTH INCREASE THE COSTS, AS VERIZON SUGGESTS?

A. No, it is quite the contrary. The rationale for including additional capacity is to be able to provide additional services, and presumably recognize revenues for those services. I seriously doubt that Verizon would put in place additional capacity if it was required to bear the full carrying cost of that investment. Nor does Verizon simply let today's customers pay for the entire network and allow new users to receive telecommunications services free of cost.

To illustrate that planning for additional growth actually lowers the overall cost *per line* of telecommunications plant, I have run an analysis showing how the loop costs I presented in my Direct Testimony would have been lower had I assumed additional years for growth.

Table 1
Impact of Additional Capacity and Growth on Model Loop Results

Category	Year		Annual Change	Total Change
	Rates - 2004	Rates - 2006		
Total Investment	$ 1,948,785,033	$ 2,092,758,083	3.63%	7.39%
Annual Operating Expenses	$ 206,163,744	$ 218,275,519	2.90%	5.87%
Monthly Cost per Line				
Capital Cost	$ 3.33	$ 3.00	-5.13%	-9.99%
Operating Expenses	$ 2.58	$ 2.29	-5.81%	-11.28%
Total TELRIC Cost	**$ 5.92**	**$ 5.29**	**-5.42%**	**-10.56%**

As the above table demonstrates, if I had run the Synthesis Model including additional capacity and attributed a *portion* of those costs to future customers, I would have developed costs *ten percent lower* than those submitted in my direct testimony. Indeed, by placing a network for less growth and recovering those costs from fewer customers, the Synthesis Model as I have filed it here has produced conservative costs by not including the full scale and scope of the forward-looking network.[17]

C. The Synthesis Model is Verifiable and has Been Validated by Significant Public Scrutiny

Q. VERIZON CLAIMS THAT IT IS DIFFICULT TO ANALYZE THE ASSUMPTIONS AND ALGORITHMS UNDERLYING THE SYNTHESIS MODEL, IN PART BECAUSE IT IS WRITTEN IN TURBO PASCAL. HOW DO YOU RESPOND?

[Tardiff @ 22-25, Murphy @ 15]

[17] This comparison is made using the model filed in the AT&T/WorldCom Initial Filing with the exception of using year-end 2003 line counts instead of year-end 2002 line counts to estimate the mid-point of the applicable rate period. All forecasts were made using the exact same data and methodologies presented in my direct testimony.

A. Like any cost model -- or, for that matter, any ILEC cost study -- the Synthesis Model is complex. It is attempting to analyze forward-looking economic costs on a location-specific basis to satisfy demand throughout a particular state.

Turbo Pascal is no longer as commonly used as some other programming languages. Nevertheless, I have been able to analyze the Synthesis Model's algorithms and assumptions by examining and reviewing the Model.

Both GTE and Bell Atlantic provided numerous comments on the Synthesis Model during its development (in fact, as described above, many of Verizon-VA's criticisms in this proceeding repeat issues already raised by Verizon and rejected by the FCC during earlier proceedings on the Synthesis Model).[18] In addition, the FCC held frequent meetings and workshops with representatives from ILECs and CLECs to discuss issues surrounding both the model development and inputs, and provided parties with ample opportunity to comment. In order to provide these comments and to participate in these meetings and workshops, GTE and Bell Atlantic obviously were able to understand and manipulate the Model. The FCC has also released an uncompiled version of the Model's source code, which facilitates making modifications and conducting sensitivity studies. This uncompiled version of the source code was provided with the Synthesis Model I filed as part of *AT&T/WorldCom Initial Filing*.[19]

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[18] I understand that Turbo Pascal is no longer sold in the United States. I have worked with Borland to negotiate the right to distribute the Turbo Pascal software in regulatory proceedings where I am filing the Synthesis Model. We would have gladly provided this software to Verizon had they requested it. It is fair to assume that Verizon already has a copy based on GTE's and Bell Atlantic's extensive comments during the development of the Synthesis Model and the fact that not one of Verizon's data requests asked for any technical assistance with the model.

[19] Specifically, the Synthesis Model source code is included in the directory titled "source" in the HCPM model. This source code has also been available for years on the FCC's website along with the Synthesis Model.

As for Verizon-VA's claim that the Synthesis Model required a stand-alone computer with Microsoft Access 97, instead of Access 2000, this is simply incorrect. Both Microsoft Access 2000 and Microsoft Access 97 can be loaded and used on the same machine (as I have done) without rendering the machine unavailable for other uses when the model is not running. As for the model crashing, I am unaware of any such problems when the model is correctly installed onto a computer, and am somewhat baffled that Verizon had this problem. I have not experienced any of the difficulties claimed by Verizon, and I was not contacted to assist Verizon if and when they may have encountered these difficulties.[20]

I have found the documentation adequate, and have been able to use Turbo Pascal both to evaluate and modify the Synthesis Model. Furthermore, I have not found the version of Microsoft Access used by the Synthesis Model to be an impediment to running, analyzing or modifying the Model.[21]

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[20] If contacted, we could have attempted to assist Verizon-VA in getting the Synthesis Model to run correctly. Furthermore, the criticisms of Messrs. Tardiff and Murphy ring hollow in light of the difficulty Mr. Baranowski has had in running Verizon's various cost model programs. As I understand it, Verizon's LCAM and VCost models not only require the same version of Microsoft Office 97 that is used to run the Synthesis Model, but also rely on an outdated version of personal Oracle, which must be purchased through Verizon because Oracle no longer supports the outdated version of the software. In addition, I understand that Mr. Baranowski was not able to make certain changes to Verizon's model such as line counts because the program effectively prevented any adjustments by the user to the engineering survey data. This violates at least one of the FCC's "Criteria for Forward-Looking Economic Cost Determinations," which requires: The cost study or model must include the capability to examine and modify critical assumptions and engineering principles. *First Report and Order* at 250(8-9), footnotes deleted. In contrast, the Synthesis Model clearly satisfies the FCC criteria as the inputs and algorithms can be changed and tested.

[21] It is telling that Messrs. Murphy and Tardiff did not attempt to correct any of their claimed flaws with the Synthesis Model to determine the extent of its purported distortions. Their testimony would have been more helpful to this Commission if they had actually recommended changes that would correct for their criticisms.

Q. VERIZON ALSO CLAIMS THAT THE SYNTHESIS MODEL HAS CALCULATION ERRORS WHICH PROVE IT IS UNTESTED. IS THIS CORRECT?

A. No. The fact that calculation errors may be uncovered in a model does not mean that it is untested or unreliable. Furthermore, as discussed by in both the Panel Rebuttal and Mr. Baranowski's surrebuttal testimonies, Verizon's models also suffer from numerous calculation errors. As he explains, these calculation errors, when found, were corrected, but due to the complexity and breadth of the Verizon Models one cannot be sure that all of the errors have been discovered.

D. The Synthesis Model Produces Accurate Estimates When Compared to Other Benchmarks

Q. VERIZON PRESENTS A SERIES OF COMPARISONS IN AN EFFORT TO SUGGEST THAT THE SYNTHESIS MODEL UNDERSTATES COSTS. WOULD YOU PLEASE ADDRESS THESE COMPARISONS?

[Tardiff @ 26-43]

A. Yes. Dr. Tardiff's Rebuttal Testimony makes the following claims:

- The Synthesis Model as filed in the *AT&T/WorldCom Initial Filing* produces costs considerably lower than those produced by the original Synthesis Model for Verizon-VA [*Tardiff @ 26-29*];
- The Synthesis Model produces costs 56 percent lower than the HAI Model Version 3.1 results filed by AT&T/WorldCom in Virginia four years ago [*Tardiff @ 33-34*]; and

- The investment and expenses produced by the Synthesis Model for Verizon-VA are far below the investment and expenses reflected in Verizon-VA's ARMIS data for year 2000 [*Tardiff @ 35-43*].

Q. IS THERE ANY BASIS FOR DR. TARDIFF'S COMPARISON OF THE SYNTHESIS MODEL TO THE FCC'S DEFAULT SYNTHESIS MODEL?

[Tardiff @ 26-29]

A. No. At page 27 of his Rebuttal Testimony, Dr. Tardiff states that the original Synthesis Model produces total loop costs for Virginia of $19.16, whereas the Synthesis Model presented in this proceeding produces costs of only $5.92.

First, this comparison is misleading because, in part, it relies on an apples-to-oranges comparison of data from different time periods. My use of current data is in keeping with the FCC's continued use of the most current line count data available.[22] Thus, Dr. Tardiff's comparison ignores the fact that I have used forecasted 2002 demand (line counts, dial equipment minutes and call completion) and expenses in the Synthesis Model, while the original Synthesis Model relied on data from 1998. During this time frame, demand has increased significantly while common support services expenses have remained virtually flat. Given the economies of scope and scale inherent in telecommunications, it is not surprising that certain costs have declined from this fact alone.

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[22] *Inputs Order* at 61. "We subsequently have modified those data to reflect the most currently available ARMIS data. Accordingly, the input values that we adopt in this Order will true up the line counts generated by the National Access Line Model to 1998 ARMIS line counts.

Second, the $19.16 cited by Dr. Tardiff includes a 1998 national average of $7.32 allocated to the loop for common support services expenses. To be more timely and state-specific, I used Verizon-VA specific data, and associated the common support services expenses to the underlying elements, rather than applying all of these expenses to the loop. I also excluded marketing costs because these costs are predominantly retail-related, and I limited the services expenses to the portion related solely to wholesale functions.

Third, I identified several deficiencies in the way in which the original Synthesis Model constructed plant. Correcting these errors (*see* Direct Testimony, Exhibit D) reduces costs when compared to the original Synthesis Model.

In short, the cost comparison cited in this section of Dr. Tardiff's Rebuttal Testimony are explained by the changes I have made to the inputs and to certain model logic -- they do not suggest that the Synthesis Model platform is flawed. Although I believe the changes I have made are appropriate, the Synthesis Model platform is perfectly capable of accurately calculating forward-looking economic costs for Verizon-VA using a different set of inputs and assumptions. The fact that Dr. Tardiff objects to my inputs and assumptions does not impugn the use of the Synthesis Model in this proceeding, especially in light of the fact that Messrs. Tardiff and Murphy highlight that the FCC has itself acknowledged that the model inputs may need to be adjusted for UNE purposes.

Q. DO DR. TARDIFF'S "VALIDATIONS" AGAINST PAST MODELS HAVE ANY MERIT?

[Tardiff @ 33-34]

A. No. Dr. Tardiff's reliance upon severely outdated data and models that have been updated and improved does nothing more than highlight that the characteristics of the local service market in Virginia have changed, including demand and expenses, rather than remaining "static," as Dr. Tardiff's comparisons implicitly assume. The HAI Model Version 3.1 submitted by AT&T/WorldCom in the prior UNE proceeding relied upon line counts and ARMIS data for year 1996 while the HAI Model Version 5.0a, copyrighted in 1998, appears to have been run by Dr. Tardiff with 1998 vintage data. One cannot compare or evaluate different models without, at a minimum, ensuring that the inputs are the same. Dr. Tardiff's run of the HAI Model 5.0a is especially problematic because that run did not attempt to include *any* Virginia-specific inputs while the other two runs purportedly do.

Aside from the obvious problems of inconsistent demand data and inconsistent input assumptions when comparing models, Dr. Tardiff also fails to consider the significant improvements in customer location data, clustering, and outside plant algorithms that have taken place since 1996. The FCC Staff developed the Synthesis Model to correct for the less accurate data in prior models and to advance the accuracy of the outside plant algorithms. It is not surprising that the Synthesis Model, which relies less extensively on *assumptions* to locate and build plant to customer locations than other models, will more accurately estimate the amount of plant required.

In short, Dr. Tardiff's analysis disregards the most basic economic changes in demand and expenses over the past few years, ignoring TELRIC in his purported validations. Moreover, Dr. Tardiff's failure to account for changes in input values and assumptions renders his comparisons among models invalid. Finally, by not recognizing the dramatic

advancements in the state-of-the-art in cost modeling, Dr. Tardiff ignores a major contributor to changes in modeled investments. Thus, Dr. Tardiff's results, presented in Table 2 in his Testimony, are of no value in determining the appropriate current forward-looking costs associated with these UNEs.[23]

Q. WHAT WOULD ONE EXPECT IN ANALYZING CHANGES IN DEMAND AND EXPENSES OVER TIME?

A. All else being equal, investment increases over time while investment per line decreases over time as a result of the economies of scale and scope in Verizon-VA's network. [24] I have performed several sensitivity runs to illustrate the effect of the changes in demand and expenses on the Synthesis Model -- all else being held constant.

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[23] Furthermore, HAI Version 5.2.a, released on February 7, 2000, was not included in this analysis, although Dr. Tardiff is clearly aware of this more current release (as he discusses HAI assumptions in NY and Massachusetts cost cases in which HAI Version 5.2a was presented). Tardiff @ 33.

[24] Dr. Tardiff repeatedly cites a WorldCom Supreme Court Brief to support his view that loop costs have increased but seems to take this statement out of context, which appears to be referring to the increase in system-wide total loop cost, not per line loop costs -- which have declined.

Table 2
Changes in Demand and Expenses Over Time on Model Loop Results

Category	Year 1996	Year 2002	Annual Change	Total Change
Total Investment	$ 1,547,977,076	$ 1,948,785,033	3.91%	25.89%
Annual Operating Expenses	$ 191,110,157	$ 206,163,744	1.27%	7.88%
Monthly Cost per Line				
Capital Cost	$ 5.11	$ 3.33	-6.89%	-34.83%
Operating Expenses	$ 4.63	$ 2.58	-9.29%	-44.28%
Total TELRIC Cost	**$ 9.74**	**$ 5.92**	**-7.96%**	**-39.22%**

As the above table demonstrates, increases in demand actually increase the investment developed by the Synthesis Model, as one might expect. However, the effects of economies of scale generated by increased demand and lower per-line operating costs more than offset the increased investment, thereby producing much lower average costs per line.

Q. DO DR. TARDIFF'S "VALIDATIONS" AGAINST VERIZON'S BOOK DATA HAVE ANY MERIT?

[Tardiff @ 35-43]

A. No. Dr. Tardiff's assertion that the Modified Synthesis Model is flawed because it produces costs below Verizon-VA's embedded costs is wrong.

First, AT&T/WorldCom have validated the Synthesis Model results for Verizon-VA by comparison with runs of the Verizon-VA cost models using comparable inputs. Even a partial correction of the erroneous inputs in Verizon-VA's own models reduces their

outputs to levels comparable with those in the Synthesis Model (See Attachment 1 to the Panel AT&T/WorldCom Rebuttal Testimony).

Second, Dr. Tardiff's comparison of the Modified Synthesis Model results with Verizon-VA's *embedded* costs or investments actually provide further support for the Synthesis Model results. By definition, embedded ARMIS values do not reflect Verizon-VA's forward-looking economic costs of providing UNEs or the amount Verizon-VA claims as its forward-looking economic costs. Embedded costs are unlikely to equal the long run forward-looking costs of an efficiently designed and operated network, and thus ARMIS data cannot be used as a test of the reasonableness of forward-looking estimates.

Verizon has historically operated as a regulated monopoly and has been faced with little or no real market pressure from alternative providers. As a result, it has not been forced to shed the monopolistic inefficiencies built into its system from the very beginning.

For this reason, the FCC has rejected the comparison of embedded costs and forward-looking economic cost as a mechanism for evaluating estimates of a firm's forward looking costs:

> We do not agree, as some parties have argued, that the models' outside plant design parameters should be verified by comparing the design of the model networks in specific locations to the design of incumbent LECs' existing plant in those locations in all cases. While we recognize that certain factors such as terrain, road networks, and customer locations are fixed, the design of the existing networks under these conditions may not represent the least-cost, most-efficient design in some cases. The Commission, in the *Universal Service Order*, adopted the Joint Board's recommendation that universal service support should be based on forward-looking economic costs. Existing incumbent LEC plant is not likely to reflect forward-looking technology or design choices. Instead, incumbent LECs' existing plant will tend to reflect choices made at a time when different technology options existed or when the relative cost of equipment to labor may have been different than it is today. Incumbent LECs' existing plant also was designed and built in

> a monopoly environment, and therefore may not reflect the economic choices faced by an efficient provider in a competitive market. Although we do not believe that a forward-looking platform can meaningfully be verified by comparing its network to an embedded network, we note that the platform is only one of many considerations used to set actual levels of support.
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> *Platform Order, at 66* (footnotes deleted).

The FCC also clearly indicated in the *First Report and Order* that embedded costs are not only inappropriate, but "the costs *must* not be the embedded cost of the facilities functions, or elements."[25]

Third, in comparing the Modified Synthesis Model results to Verizon's actual expenses and investments, Dr. Tardiff made no attempt to back out any cost inefficiencies reflected in Verizon-VA's embedded ARMIS data before making this comparison.[26]

Fourth, ARMIS data contain a number of investments and costs, whether or not forward-looking or efficiently incurred, that should be excluded from any comparison made to UNE rates because they are not causally attributable to the provision of UNEs estimated by the Synthesis Model. These costs include, for instance, DSLAMs, broadband investment, investment in capacity acquired in anticipation of providing inter-exchange service, and retail costs such as marketing and most product management expenses. The Synthesis Model appropriately assigns significant portions of general support and overhead investment and expenses (such as those associated with building, land, furniture, and general purpose computers) to non-UNE activities, and excludes them from the Model's calculations. Attribution of such costs to the particular network elements

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[25] First Report and Order at 250, Criteria 3.
[26] "The '2000 Actual' data in Table 3 is taken from Verizon-VA's ARMIS reports." Tardiff Reply at 35.

costed by the Synthesis Model would violate the causation requirement of TELRIC.[27] Dr. Tardiff, however, made no attempt to back out any of these extraneous costs before performing his comparison with the Synthesis Model outputs.

Q. HOW DOES VERIZON DISTORT THE WORLDCOM STATEMENTS THAT IT REPEATEDLY CITES?

[Tardiff @6 & 46]

A. Dr. Tardiff cites WorldCom's brief to the Supreme Court (see Tardiff at 6) and a statement by a WorldCom employee in an article titled "Application of Real Options to TELRIC Models: Real Trouble or Red Herring" (see Tardiff at 46), but distorts both statements in making arguments about the Synthesis Model. He asserts that these statements are inconsistent with the Synthesis Model showing that investments have decreased since 1996. However, as I demonstrate in the table above, the Synthesis Model shows that investments are 25% higher today than they would have been in 1996 using the same assumptions and input values. However, due to greater demand and small growth in expenses, the *per-line* costs have dropped significantly.

In fact, the TELRIC estimates produced by the Synthesis Model are validated by Verizon's own statements in the same Supreme Court proceeding that Dr. Tardiff cites. In a Verizon brief to the Supreme Court, Verizon notes that TELRIC typically results in costs that are 50 percent to 60 percent below "historical" cost.[28] These reductions are of

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[27] Local Competition Order at 682, 691.
[28] Brief of Petitioners Verizon Communications Inc. *et al*, in *Verizon Communications Inc. v. FCC*, No. 00-511 (U.S. filed Apr. 9, 2001) at 10-11.

the magnitude that Dr. Tardiff derived by comparing the Synthesis Model with ARMIS or other embedded cost data. This suggests that the Synthesis Model calculates TELRIC accurately.

In effect, the results of Dr. Tardiff's comparison amount to a complaint about the TELRIC standard itself -- they do not impugn the way in which the Synthesis Model calculates TELRIC for Verizon-VA.

Q. ARE ANY COMPARISONS WITH OTHER DATA APPROPRIATE?

A. Yes, but not with embedded investment and expense data. There are fundamental inconsistencies between embedded investments and forward-looking investments that render any comparisons invalid. The investment accounts in ARMIS are based on gross investment made at some point in the (often distant) past, and reflect what is likely to be a less-than-optimal network configuration, given current demand. These differences cause fundamental disconnects between both the investment values in ARMIS and the investment values resulting from a TELRIC application, between the investment values in ARMIS and the equipment quantities reported in ARMIS, and between the equipment quantities reported in ARMIS and the equipment quantities resulting from a TELRIC application. This can be seen by comparing Dr. Tardiff's conclusion that the Modified Synthesis Model produces 57% of ARMIS investments while Mr. Murphy provides evidence that the Synthesis Model produces approximately 85% of the sheath distance (I believe this is an apples-to-oranges comparison because the number Dr. Tardiff uses in

his Synthesis Model comparison is route distance, not sheath distance).[29] Since both copper and feeder frequently extend over the feeder network in order to terminate either copper or feeder at different customer premises, route distances will necessarily understate sheath distances by the magnitude of this overlap. Consider feeder cable for example. The typical feeder route emanating from a central office will have *both* fiber and copper feeder cable with the copper cable serving the closer distribution areas and fiber cable serving the further distribution areas. Thus, it is clear that comparing Synthesis Model *route* miles to actual *sheath* miles is inappropriate.. Hence, the 85% is clearly understated, and the actual percentage sheath miles developed by the Synthesis Model is likely to be much closer to 100% of Verizon's actual network. In other words, a more valid approach would entail a comparison of facilities built, although it is still not particularly meaningful.

The most appropriate form of validation for a cost proxy model is to compare the results of one model with other models that claim to serve the same function. I have performed such an analysis and received empirical confirmation in a controlled comparison with the original Synthesis Model and two other models in Florida. The comparison showed that the Synthesis Model specified substantially *more* route distance cable than the other two models in the comparison, *i.e.*, the HAI Model and the Bell South Telecommunication Loop Model ("BSTLM").

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[29] Murphy Reply, footnote 109.

Table 3
Comparison of Route Miles

Model	Distribution	Feeder	Shared	Total	Difference
Synthesis Model with Source Code Changes	64,654	8,164	-	72,818	
FCC's Original Synthesis Model	81,660	8,139	-	89,799	23.32%
HAI Model 5.0a	47,557	10,362	-	57,919	-20.46%
BSTLM (With Shared Route)	37,048	2,001	5,803	44,852	-38.41%

Source: October 2, 2000 Ex Parte Presentation.

Thus, Mr. Murphy's assertion that the Synthesis Model has not been validated is inaccurate.

In addition, as noted earlier, the Synthesis Model results have been validated by Mr. Baranowski's adjustments to Verizon's various cost studies. These studies, which rely heavily on embedded data, actually confirm the Synthesis Model results when appropriate forward-looking adjustments are implemented.

III. VERIZON'S CLAIMS OF SYNTHESIS MODEL ERRORS LACK MERIT AND SHOULD BE DISREGARDED BY THIS COMMISSION

A. The Synthesis Model is The Best Model Available for Estimating the TELRIC of Providing the UNE's Estimated by the Synthesis Model

Q. VERIZON CONTENDS THAT THE SYNTHESIS MODEL IS INCAPABLE OF MODELING LOOPS THAT SUPPORT A WIDE RANGE OF SERVICES INCLUDING DARK FIBER, ISDN, DDS, DS-1, AND DS-3. IS HE CORRECT?

[Murphy @ 16-19]

A. No. My testimony uses the Synthesis Model to estimate the cost of a two-wire loop, consistent with the FCC's prior determinations on the appropriate way to incorporate the